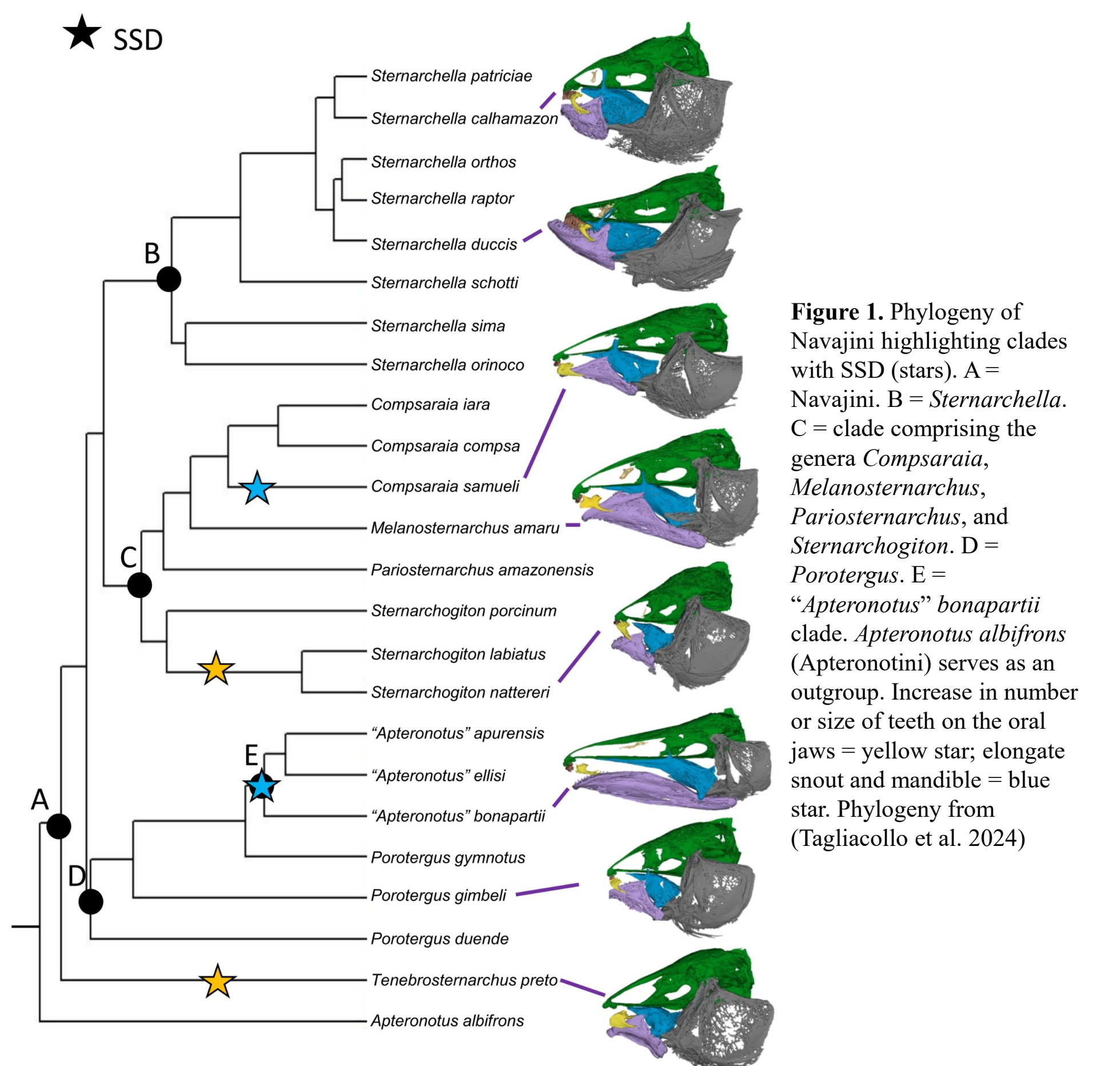


# Ecological Specialization and Craniofacial Evolution in Deep-Channel Ghost Electric Fishes (Navajini, Aptereronotidae)

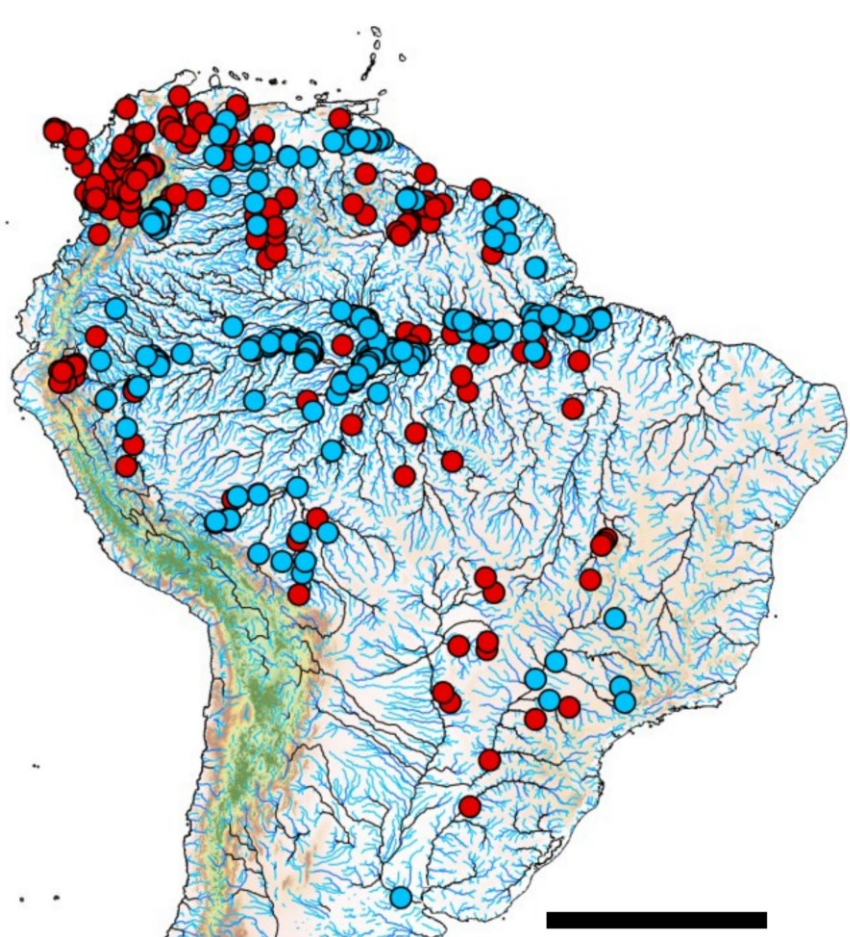
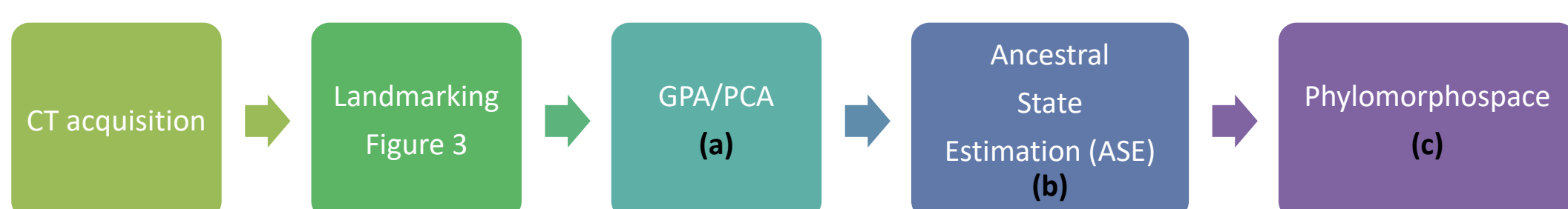
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## Introduction and Aim

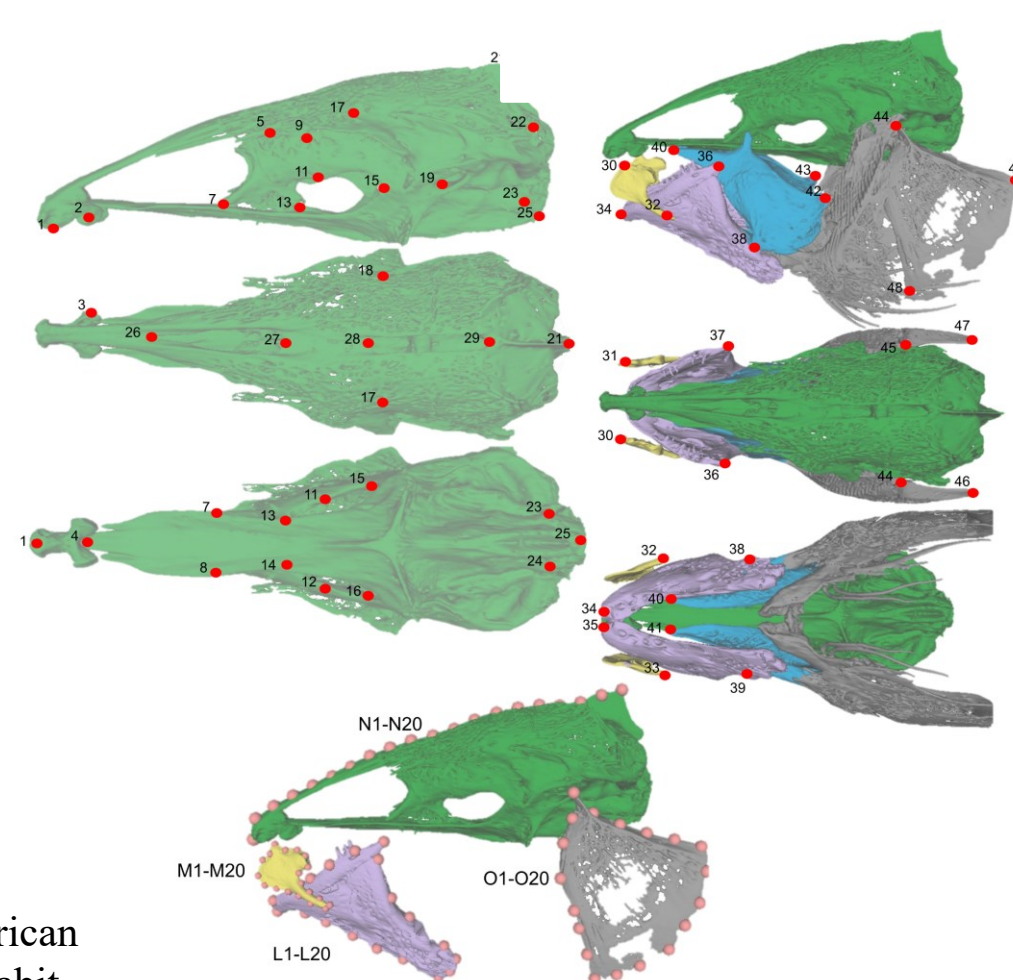


- Deep river channels of South America are extreme and understudied ecosystems with unique selective pressures shaping fish evolution (Lundberg and Fernandes, 2007)
- Navajini (Aptereronotidae), a diverse clade of electric fishes, show remarkable craniofacial disparity (**Figure 1**)
- Secondary sexual dimorphism (SSD), notably elongated jaws and teeth in males, observed in central Amazon (Kolmann and Crampton, 2019)
- Ecological separation between river margins and deep channels has likely promoted contrasting adaptive trajectories and species richness patterns
- This study uses microCT imaging, geometric morphometrics (GMM), and phylogenetic analyses to test whether ecological specialization and SSD jointly explain craniofacial evolution in Navajini (**Figures 2 & 3**)

## Methods

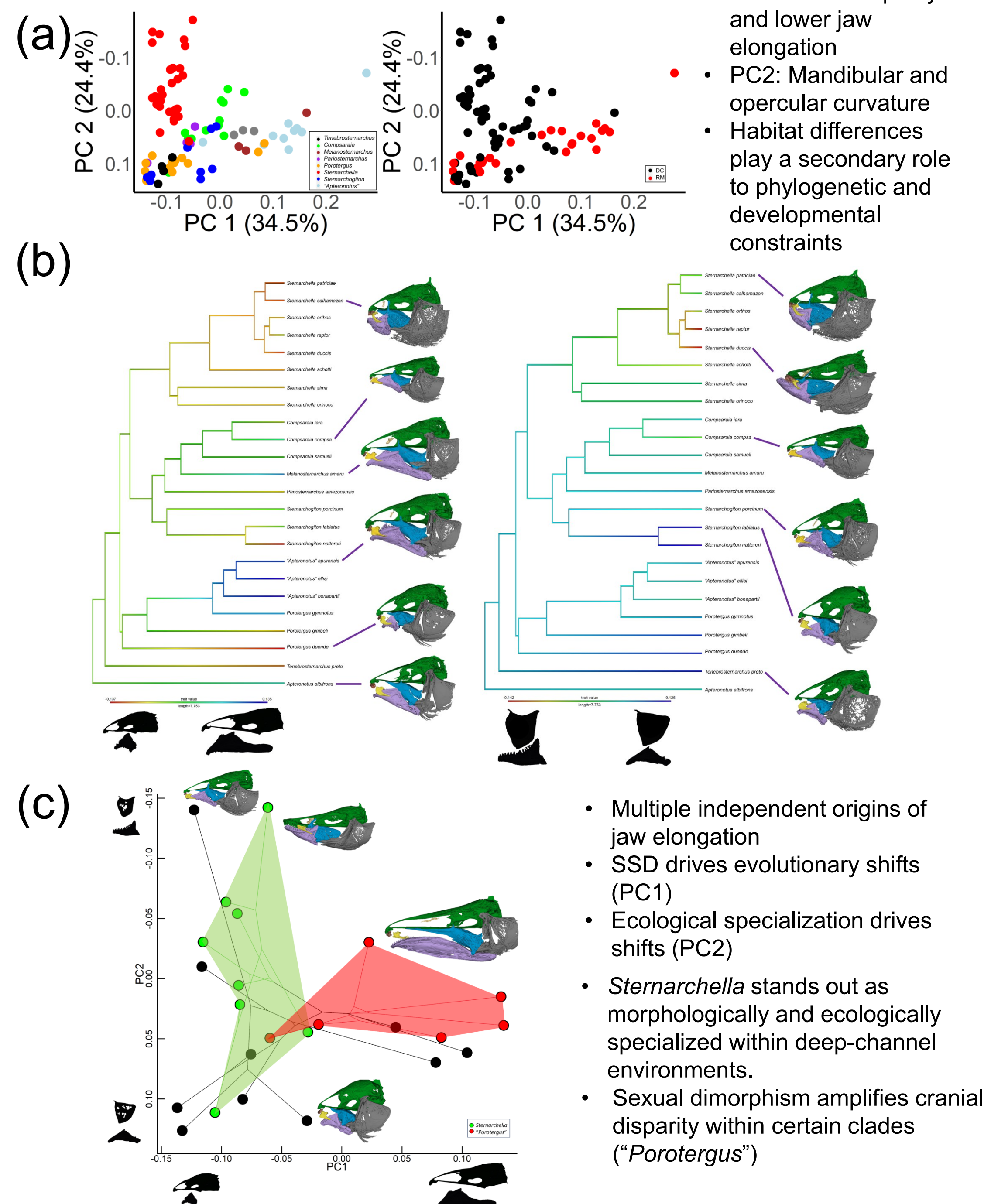


**Figure 2.** Geographic distributions of Navajini species in South American rivers by Strahler stream order (SO). Navajini (blue circles) inhabit large river channels (SO 6-10, black lines). Aptereronotini (red circles) inhabit margins of large rivers and small rivers (SO 4-5, blue lines). Scale bar = 1,000 km.



**Figure 3.** Landmark scheme for GMM of skull shape analysis of *Sternarchogiton porcinum*.

## Results



## Discussion

- Ecological divergence and sexual selection act together to generate extensive shape variation across the clade (Ford et al., 2022)
- Jaw elongation evolved independently at least three times illustrating repeated adaptive convergence (Albert and Crampton, 2009)
- *Sternarchella*'s unique cranial traits (curved, short jaws, superior mouth position) linked to piscivory and tail-biting behavior
  - Adaptive divergence in feeding strategies
- Pronounced SSD restricted to Amazon Basin where ecological complexity, flooding dynamics, and species overlap may foster sexual selection and trait exaggeration
- "*Aptereronotus*" *bonapartii* group exemplifies diversification through ecological opportunity
  - Frequent river capture events and habitat fragmentation in small rivers promote dispersal and niche exploitation (Albert et al., 2020)

## References

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